Management Plan for the South Holston Tailwater Trout Fishery 2004-2008


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South Holston Tailwater Trout Fishery Management Plan (2004-2008)

I. Goal

The Tennessee Wildlife Resources Agency (TWRA) seeks to maintain a high-quality trout fishery in the South Holston tailwater (South Fork Holston River) while providing a variety of opportunities to the anglers who enjoy this resource.

II. Objectives

TWRA's primary strategy for attaining the management goal set for the South Holston tailwater will be to continue providing put-and-take and put-and-grow fisheries for rainbow trout *Oncorhynchus mykiss,* with emphasis to remain on put-and-grow management. Additionally, the South Holston tailwater's ability to produce wild brown trout *Salmo trutta*, which is comparatively unique among Tennessee's tailwaters, will be featured by eliminating stocking (put-and-grow management) of this species. Given these basic strategies, TWRA will strive to meet the following management objectives during 2004-2008:

- *Improve the abundance of large trout in the fishery*. The current 16-22 inch protected length range (PLR) will be evaluated during 2004-2008 to address this objective. Electrofishing catch rates for 16-22 inch fish prior to establishment of the PLR (mean, 11.7 fish/h) will be compared with subsequent catch rates.

- *Create a brown trout fishery consisting entirely of wild fish.* This objective will be achieved if natural reproduction by brown trout is capable of sustaining that fishery at recent levels of abundance as indicated by average electrofishing catch rates for monitoring samples since 1999 (90 fish/h ≥7 inches; 17 fish/h ≥14 inches).
- *Optimize fingerling rainbow trout stocking rates.* Rainbow trout fingerling stocking rates have increased since 1997, but electrofishing catch rates for this species have remained

at about 40 fish/h (≥7 inches) since 1999. Since higher stocking rates have not increased rainbow trout abundance, identification of a lower rate that does not reduce current abundance will meet this objective.

III. Background

The South Holston tailwater was created in 1950 when the Tennessee Valley Authority (TVA) completed construction of the dam at South Fork Holston River Mile (SFHRM) 49.8 in Sullivan County, Tennessee. The reservoir upstream of the dam (7,580 acres) has a drainage area of 703 $mi.^2$ and extends 24 miles upstream into Washington County, Virginia. Much of the watershed is forested and includes portions of the Cherokee National Forest (Tennessee) and the Jefferson National Forest (Virginia). TVA operates South Holston Reservoir primarily for flood control and power production. The dam has one turbine capable of producing a maximum of 38,500 kW and an average discharge of 2,400 cfs (68 m^3/s). The tailwater extends approximately 13.7 miles between the headwaters of Boone Reservoir and South Holston Dam. It has an average width of 131 ft. and a surface area of about 217 acres at base flow (Bettoli et al. 1999).

Turbine discharges from South Holston Dam historically experienced a period of low dissolved oxygen (DO) during summer and fall (Scott et al. 1996). While this DO depression was not as severe as those in other TVA tailwaters, it was a concern for the trout fishery. To address low DO levels and a lack of minimum flow in the tailwater, TVA constructed an aerating labyrinth weir at SFHRM 48.5 (~1.25 miles below the dam) as part of its Reservoir Releases Improvement Program. The weir, completed in December 1991, maintains a minimum flow of 90 cfs (2.55 m^3/s) in the tailwater and recovers approximately 40-50% of the oxygen deficit as water passes

over it (Yeager et al. 1993). The turbines are typically pulsed twice daily to maintain the weir pool. Additionally, releases from South Holston Dam have been aerated via turbine venting since 1992 (Scott et al. 1996). The weir and the turbine improvements combine to help maintain the target DO concentration of 6 ppm. Bettoli et al. (1999) found that DO levels downstream of the weir were suitable for good trout growth and survival and that water temperatures were usually below 68 ºF (20 ºC) and did not exceed 71.6 ºF (22 ºC).

Trout (fingerling and adult rainbow and brook trout) were first released in the South Holston tailwater in 1952. Subsequently, the South Holston tailwater has been managed as a put-and-take and put-and-grow trout fishery through annual stockings of both catchable and fingerling rainbow and brown trout. Bettoli et al. (1999) documented substantial natural reproduction, particularly by brown trout, and an overwintering trout biomass (80% brown trout) that ranked highest among Tennessee tailwaters and rivaled other high-quality tailwater trout fisheries in the U.S. (Bettoli et al. 1999). The South Holston tailwater continues to support one of the finest trout fisheries in Tennessee and the Southeast. It has recently been estimated to have a total economic value of $931,525 (Williams and Bettoli 2003).

Establishment of a quality zone with special angling regulations was considered for the South Holston tailwater during 1992-1993, but never officially proposed. Later, a quality trout management regulation based on a 16-22 inch PLR was proposed and established for the entire tailwater in 1999. Additionally, snagging for all species was banned in 1999 and two major trout spawning areas were closed to fishing during November through January. These measures were taken to protect vulnerable large brown trout during the spawning season and to potentially improve recruitment. The PLR became effective in March 2000 and the spawning area closures began in November 1999.

Pfitzer's (1954) study of east Tennessee tailwaters conducted in the early 1950's included the South Holston tailwater, but TWRA made no subsequent surveys of the South Holston tailwater until 1995, when two monitoring sites were established (Bivens et al. 1996). These sites were located in the Emmett Bridge/Bristol weir area and between Webb Bridge and Weaver Pike Bridge (Figure 1). Fish and benthic macroinvertebrates were sampled annually at these stations through 1998 to establish a database on the existing fishery (Bivens et al. 1996, 1997, 1998; Habera et al. 1999). Both trout and non-salmonids were sampled with boat and backpack electrofishing gear (1 h of effort each) during low flow in late July or early August. Total electrofishing catch rates (all trout) ranged from 50-90 fish/h for trout ≥7 inches, 2-4 fish/h for trout ≥14 inches, 1-2 fish/h for 16-22 inch trout, and exhibited no particular trend (Figure 2). These efforts provided information about the fish community and sport fishery in the South Holston tailwater at a time when little other data existed. However, the small number of sample sites and potential for bias associated with stocking events rendered them inadequate for monitoring and managing this important fishery.

TVA also evaluated the sport fishery of the South Holston tailwater at four stations in 1993 and 1994 as part of its biological and water quality assessment of tributary tailwaters (Scott et al. 1996). Electrofishing catch rates (all trout) in 1994 were 98 fish/h for trout ≥7 inches, 48 fish/h for trout ≥14 inches, and 17 fish/h for 16-22 inch trout (Scott et al. 1996) and were dominated by brown trout, as were TWRA's catch rates (except in 1998). TVA considered that the water quality and minimum flow improvements had much enhanced the tailwater's trout fishery (Scott et al. 1996).

Benthic macroinvertebrate samples were also collected along with TWRA's fish samples during 1995-1998. Mean benthic taxa richness generally declined during the four-year period, as did organism abundance (Figure 3). Bioclassification scores were typically in the poor to fair

range and did improve somewhat through 1997, but dropped back into the poor range in 1998 (Figure 3). TVA noted increases in the number of benthic taxa (including EPT taxa) and a decrease in the proportion of tolerant taxa following DO and minimum flow improvements in 1991 and 1992 (Scott et al. 1996). TVA's tailwater benthic index produced scores in the fair range for most South Holston tailwater samples, and there was little change following improvements (Scott et al. 1996).

The first intensive study of the South Holston tailwater trout fishery was conducted during 1997-1998 and included an estimation of the composition and biomass of the overwintering trout population, a survey of trout spawning redds, assessments of survival and growth of stocked

trout, and a creel survey (Bettoli et al. 1999). Biomass (about 80% brown trout) was estimated to be 207 lbs./acre (232 kg/ha) in May 1997 and 151 lbs./acre (170 kg/ha) in March 1998 and exceeded that for all other Tennessee tailwaters in the 1990s (Bettoli et al. 1999). Brown trout over 20 inches (508 mm) were relatively common throughout the tailwater and fish over 27 inches (686 mm) were present (Bettoli et al. 1999). Unlike brown trout, rainbow trout in the South Holston tailwater have limited potential to reach trophy size. Bettoli et al. (1999) captured few rainbow trout exceeding 18 inches (457 mm) and none over 20 inches.

TVA collected gravid female brown trout throughout the South Holston tailwater during its sport fish assessment sampling (1993-1994) and observed brown trout spawning below the labyrinth weir shortly after its installation (Scott et al. 1996). Bettoli et al. (1999) subsequently documented 228 trout redds in December 1997 and 165 in January 1998. A follow-up study (Banks and Bettoli 2000) during the 1998-1999 and 1999-2000 spawning periods identified trout

spawning at seven distinct sites throughout the tailwater. Spawning activity peaked in mid to late-December and was most intense in the vicinity of the island at River's Way (Banks and Bettoli 2000). Bettoli et al. (1999) observed successful recruitment of wild brown trout and, to a lesser extent, wild rainbow trout. In fact, wild age-1 brown trout represented 55% of all overwintering trout in May 1997.

Bettoli et al. (1999) found that 200-d survival of stocked catchable rainbow trout was low (3-4%) in areas of high fishing pressure and better (24%) in downstream areas where pressure was lower. Stocked rainbow trout grew 0.35-0.63 inches (9-16 mm) per month, depending on stocking date and return rates were high (40-70%) except in the lower reach of the tailwater, where angling pressure and the return rate (17%) were lower (Bettoli et al. 1999). Long-term (200-d) survival of stocked brown trout was higher (56%) than that for rainbow trout, but growth (0.43 inches/month) and harvest (24%) rates were generally lower. Wild brown trout growth was similar to that for hatchery fish and growth rates of both rainbow and brown trout were comparable to those for populations in other tailwaters (Bettoli et al. 1999).

IV. Current Status

Trout Abundance

TWRA began more intensive annual monitoring of the South Holston tailwater trout fishery in 1999 using the boat electrofishing stations (Figure 1) and protocol established by Bettoli et al. (1999). These monitoring stations are sampled during the day in early March at a flow of approximately 2,400 cfs and provide an assessment of the overwintering trout populations each year before stocking begins (Habera et al. 2000, 2001, 2002, 2003).

Mean catch rate for trout ≥7 inches, the minimum size considered fully recruited to the sampling gear and technique, was 142 fish/h in 1999, then declined to 77 fish/h in 2001, which was similar to 1997 (Bettoli et al. 1999) and 1998 (Habera et al. 1999) catch rates (Figure 4).

However, the catch rate for trout ≥7 inches has steadily increased since 2001, reaching 176 fish/h in 2003. This is comparable with recent high catch rates for the Norris tailwater (average of 189 fish/h during 2001-2003), which is sampled at night.

Mean catch rates for larger fish (i.e., those ≥14 inches and those in the 16-22 inch PLR) also declined following peaks in 1999, then increased to 22 fish/h and 9 fish/h, respectively, in 2003 (Figure 4). Brown trout, which have dominated the trout fishery in the South Holston tailwater (Figure 5), were responsible for most of the recent catch rate increases. Therefore, recruitment from the exceptionally strong 2000 cohort of wild brown trout most likely led to the improved catch rates as brown trout stocking rates have not increased (Habera et al. 2003; Figure 6).

Stocking

The South Holston tailwater was stocked with about 196,000 trout during calendar year 2002 (Figure 6). Most (91%) were rainbow trout, comprising 139,000 fingerlings and 39,000 catchables (9-12 inch fish). The remainder (about 17,500 fish) was brown trout averaging about 7 inches in length. Since 1990, an average of about 101,000 trout have been stocked in the South Holston tailwater each year. This includes 51,000 fingerling and 37,000 catchable rainbow trout and 13,000 brown trout annually. Although rainbow trout stocking rates (primarily fingerlings) increased from about 50,000 in 1997 to nearly 180,000 in 2002 (Figure 6), rainbow trout catch rates remained relatively stable during that period (Figure 7) and brown trout continue to dominate the fishery. The wild brown trout produced in the South Holston tailwater have been determined to be genetically similar to the brown trout (Plymouth Rock strain) currently being stocked (Habera et al. 2003).

Angler Use

TVA documented an average of 93,419 angler-h/year on the South Holston tailwater during 1990-1998. Angling pressure doubled between 1990 and 1995 (60,000 to 122,000 angler h/year), then remained relatively stable through 1998. Trout (primarily rainbows) were harvested at a rate of 0.14 fish/h during 1991-1997. Later, Bettoli et al. (1999) estimated a total fishing pressure of 100,844 h (29, 028 trips) during March and October 1997, making it the most heavily fished tailwater trout fishery in Tennessee at the time. Anglers caught 1.11 trout/h and harvested trout at the rate of about 0.38 fish/h.

Another creel survey of the South Holston tailwater during March-October 2002 indicated a 52% decrease in fishing pressure compared to 1997 and a 39% decrease in the number of trips taken (Bettoli 2003a). The catch rate for trout increased 54% to 1.71 fish/h, while the harvest rate (0.32 fish/h) remained relatively low (Bettoli 2003a). Catch rates over 0.7 fish/h are generally considered representative of good fishing (McMichael and Kaya 1991; Wiley et al. 1993). Composition of the anglers using the South Holston tailwater trout fishery also changed somewhat from 1997 to 2002. The percentage of out-of-state anglers increased from 30% to 37% and bait anglers increased from 62% to 74% (Bettoli 2003a). It is not known what caused the large decrease in angling pressure between 1997 and 2002, but a concomitant 50% increase in fishing pressure occurred on the Wilbur tailwater (Watauga River) during the same period (Bettoli 2003b). Some explanations for these changes in fishing pressure include better access (developed and undeveloped) and more camping facilities on the Watauga River and the opportunity to float the Watauga River during minimum flow (Bettoli 2003a).

Most anglers using the South Holston tailwater trout fishery were consumptive (35%) or non-consumptive (23%) specialists, as was also the case for the Wilbur tailwater (Hutt and Bettoli 2003). These were the two most specialized subgroups of five identified by Hutt and Bettoli (2003) based on experience, resource use, expenditures, and the importance of angling. While

both subgroups emphasize angling as a form of recreation and direct most of their effort (80-90%) toward trout, consumptive anglers have a much higher tendency to harvest and eat the trout they catch (Hutt and Bettoli 2003). The relatively high proportion of non-consumptive specialists probably contributed to the low harvest frequency, as 47% of anglers on the South Holston tailwater reported harvesting trout 'rarely' or 'never' (Hutt and Bettoli 2003). Only the Wilbur tailwater had more anglers (52%) that rarely or never harvested trout.

A slot limit (16-22 inch PLR) and spawning refuge areas are currently in effect on the South Holston tailwater and support for these management strategies among anglers there was higher than at any other tailwater surveyed by Hutt and Bettoli (2003). Overall, South Holston anglers were most satisfied with the current fishing conditions compared to anglers at other tailwater trout fisheries in Tennessee (Hutt and Bettoli 2003). Based on the contingent valuation method (CVM), they were willing to pay $57.09/day for the fishing opportunities provided by current conditions on the South Holston (Williams and Bettoli 2003). Among all east Tennessee tailwater anglers, only those using the Wilbur tailwater valued their current fishing opportunities more highly (CVM; Williams and Bettoli 2003). South Holston and Wilbur anglers were unique among the eight Tennessee tailwaters surveyed by Williams and Bettoli (2003) in their willingness (CVM) to pay more for the opportunity to catch more trout as opposed to the opportunity to catch larger trout.

V. Management Recommendations

The South Holston tailwater is rather unique among Tennessee tailwaters in terms of habitat quality, production and importance of wild trout, high overwinter survival, and it's potential to produce large trout. Therefore, as recognized by Bettoli et al. (1999), several management options are possible, some of which are not available for managing other Tennessee tailwater trout fisheries. Based on this flexibility and the current status of the South Holston tailwater, the

following actions are recommended during 2004-2008 to achieve the management objectives and ultimately fulfill the management goal for this extremely valuable trout fishery.

Objective 1: Improve the abundance of large trout in the fishery

The 16-22 inch PLR became effective on the South Holston tailwater in March 2000 and was established to enhance the abundance of these trout in the fishery. Because this size group also includes a large proportion of the spawners responsible for sustaining the South Holston's wild trout, a secondary benefit of the PLR might be to increase natural reproduction and thus enhance wild trout recruitment to the fishery. The PLR has been in effect for almost four years and should be maintained through 2008. However, 2001-2003 catch rates for 16-22 inch fish do not yet indicate that any enhancement has occurred.

The exceptionally strong wild brown trout cohort from 2000 (spawned in 1999) has recruited well and the modal size range of these fish was 11-12 inches in March 2003. Some of the faster growing fish from this cohort have likely begun to enter the PLR, as suggested by the increase in the catch rate for 16-22 inch fish in 2003. Growth of these fish over the next 1-2 years should place the majority of those that survive within the PLR and provide the opportunity to adequately evaluate the effectiveness of this regulation. Additionally, a strong 2002 brown trout cohort is also entering the fishery and should help in this regard as well.

If the current PLR is capable of enhancing the abundance of 16-22 inch trout in the South Holston tailwater, it should become evident through higher electrofishing catch rates during the period covered by this management plan. Monitoring data from 1999 indicate that a catch rate of about 20 fish/h (16-22 inches) was possible in the absence of a PLR; however, catch rates for 16-22 inch trout have averaged only 6.8 fish/h since the PLR became effective. The mean catch rate for 16-22 inch fish should at least exceed the pre-PLR mean (11.7 fish/h) at some point during 2004-2008 and ideally should begin to approach or exceed 20 fish/h. Otherwise, the boundaries

of the PLR may need to be adjusted. The rarity of 16-22 inch rainbow trout, both before and after establishment of the PLR, suggests that brown trout must drive any increase in the abundance of larger fish.

Objective 2: Create a brown trout fishery consisting entirely of wild fish

The South Holston tailwater's brown trout fishery is already largely composed of wild fish; hatchery-produced brown trout (6-8 inches) have been stocked at a relatively low rate (~13,000 annually) for several years. Additionally, much of the spawning population is protected by the PLR and three of the six major brown trout spawning areas are closed to angling during the November-January spawning season (Figure 1) to help maximize reproductive success. Furthermore, the release rate for brown trout caught by anglers is high (92%), and harvest was estimated to be only 1,031 fish in 2002 (Bettoli 2003a). Given these conditions, the South Holston tailwater's brown trout appear well suited for management as a self-sustaining (wild) fishery, an option not available in other Tennessee tailwaters. Therefore, it is recommended that no brown trout be stocked during 2004-2008. Brown trout previously allocated for the South Holston tailwater can be diverted to other fisheries that lack significant natural reproduction (e.g., the Norris tailwater).

Bettoli et al. (1999) indicated that recruitment of age-1 wild brown trout in the South Holston tailwater could be variable, and such variability can lead to fluctuations in the abundance of larger trout. This occurs in wild brown trout populations in Tennessee's mountain streams (e.g., Habera et al. 2001, 2002, 2003). Despite recruitment variability, it should be apparent by 2008 if a wild brown trout population can be sustained in the South Holston tailwater that approaches abundances based on recent electrofishing catch rates (averages of 90 fish/h $\geq$7 inches and 17 fish/h $\geq$14 inches since 1999). If these abundances (i.e., catch rates) cannot be maintained strictly through natural reproduction, it is likely that attainment of Objective 1 would

also be hindered. At that point, it is recommended that brown trout stocking be resumed at the previous rate.

Objective 3: Optimize fingerling rainbow trout stocking rates

Fingerling stocking rates increased from none (1997) to 139,000 (2002), but rainbow trout abundance, as indicated by electrofishing catch rates, has remained stable (fish ≥7 inches) or declined (fish ≥14 inches) during the same interval (Figure 7). This indicates that the current fingerling-stocking rate should be reduced. It is recommended, therefore, that the fingerling rainbow trout stocking rate be reduced to 50,000 per year, which was the average stocking rate during 1990-1996 (excluding years when no fingerlings were stocked). After 2008, the stocking rate can be further adjusted (up or down) based upon how the electrofishing catch rate for fish ≥7 inches responds. If a catch rate of about 40 fish/h (the current level) can be maintained, then an even lower stocking rate might be appropriate; if not, then the stocking rate can be incrementally increased. Stocking rates for catchable rainbow trout will remain consistent with recent rates (range, 39,000-53,000; mean, 47,000 annually since 1997).

Evaluation

It is essential that the 12 South Holston tailwater monitoring stations be sampled annually during 2004-2008. Following completion of the 2008 sampling efforts, an assessment of management objective accomplishments will be made and strategies will be adjusted, if necessary, to meet the goal for managing the South Holston tailwater.

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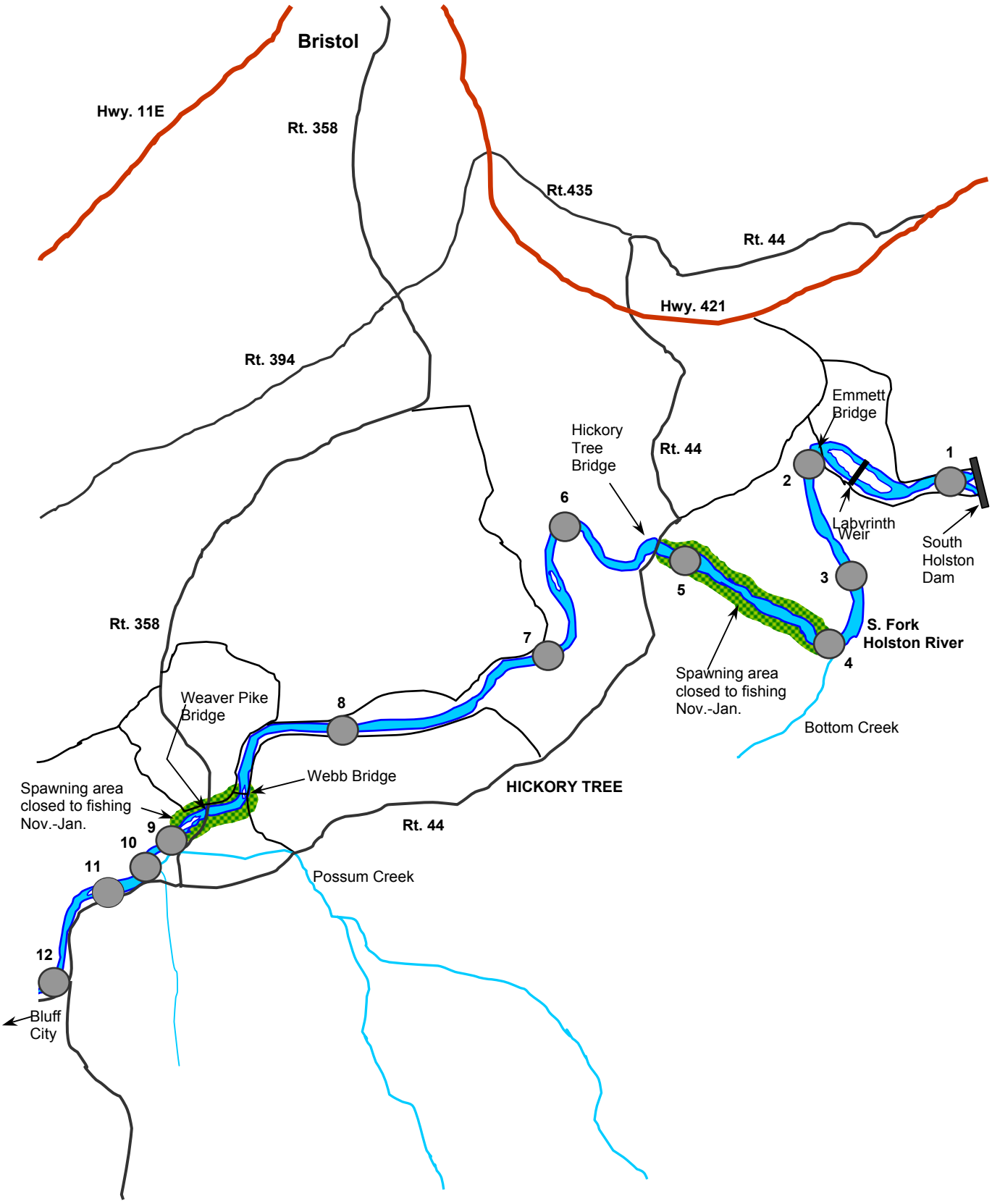


Figure 1. Locations of the South Holston tailwater (South Fork Holston River) monitoring stations.

South Holston Tailwater Catch Rates: 1995-1998

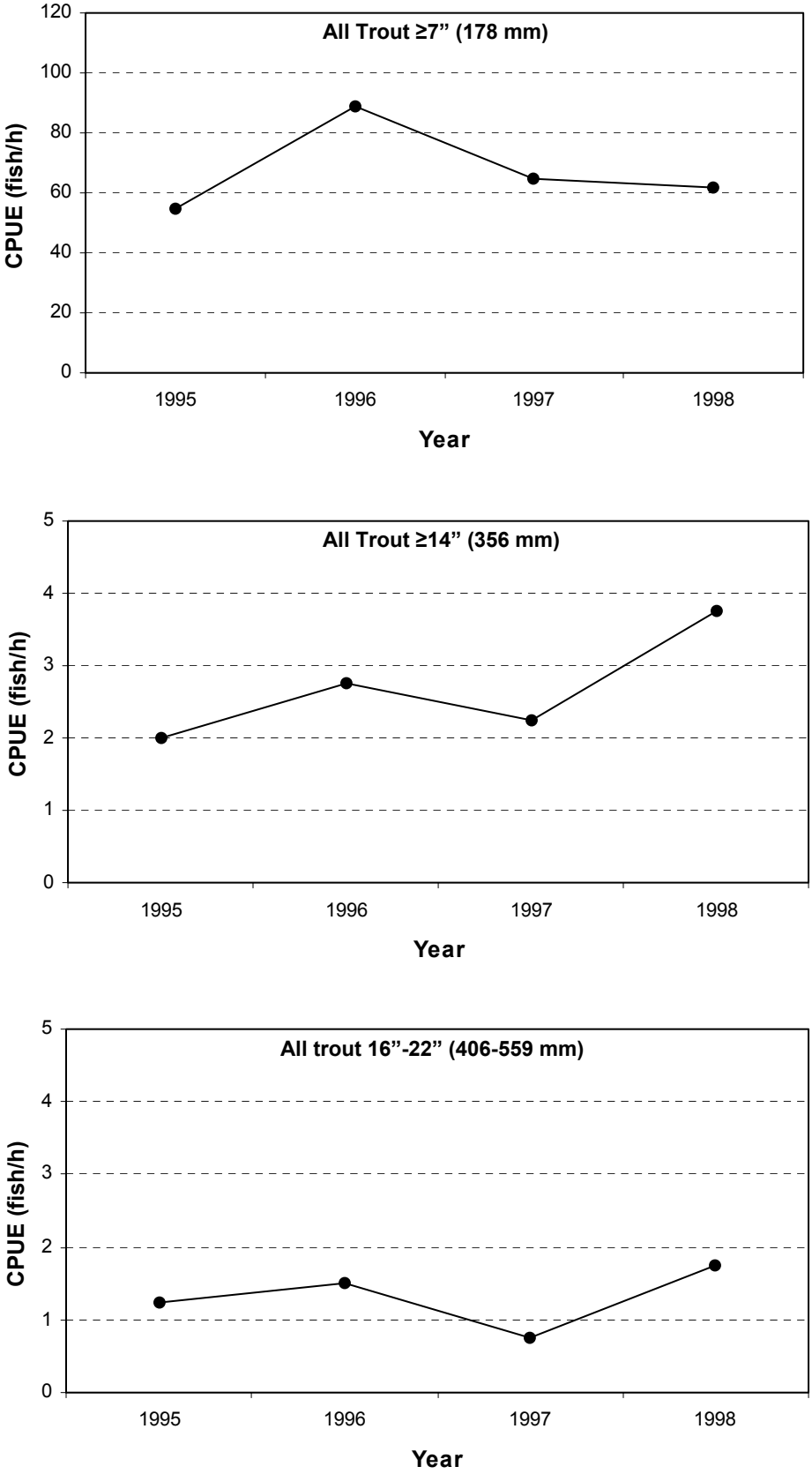


Figure 2. Mean electrofishing catch rates (all trout) at the two original South Holston tailwater monitoring stations (1995-1998).

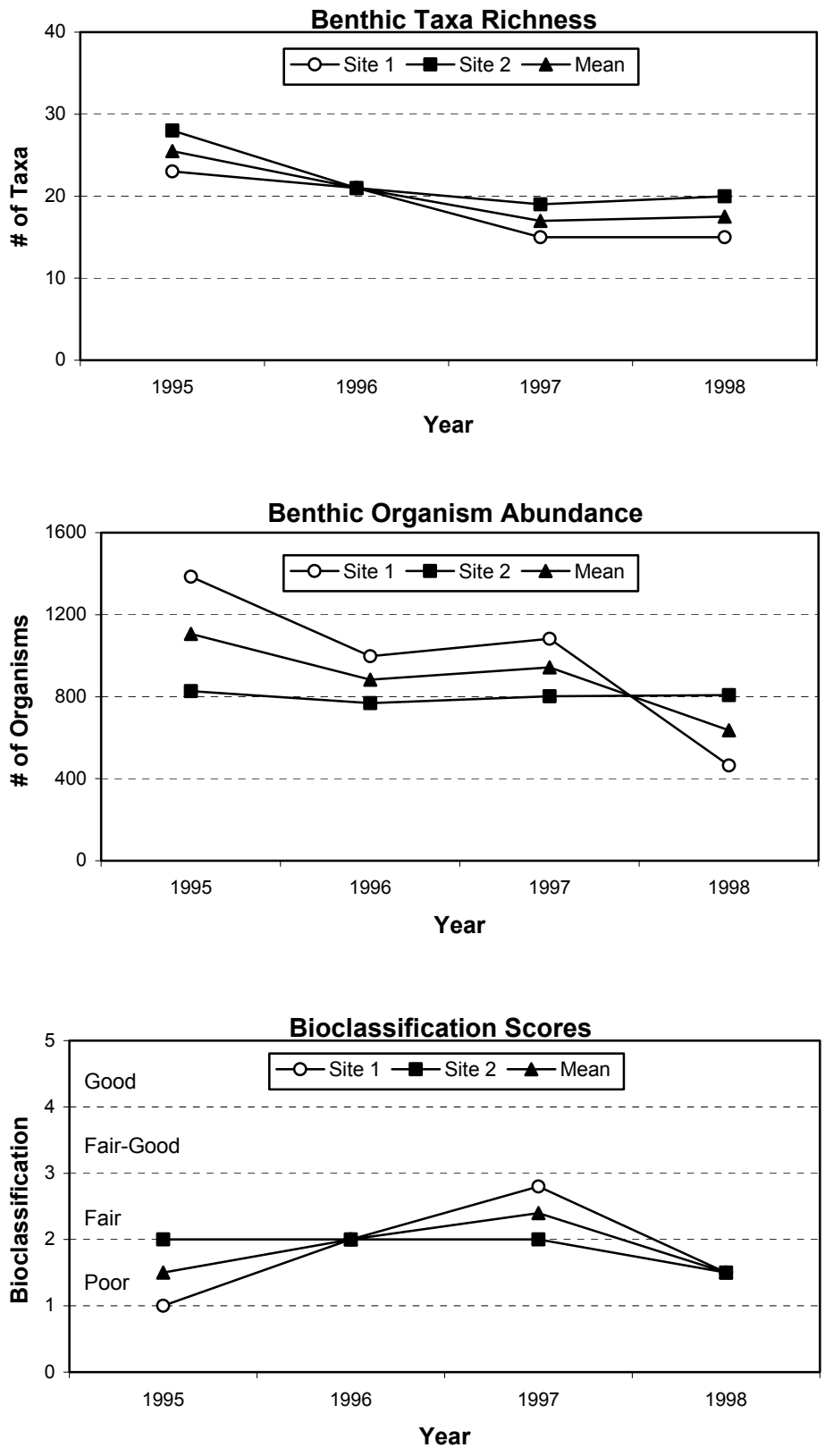


Figure 3. Benthic community characteristics for the two original South Holston tailwater monitoring stations (1995-1998).

South Holston Tailwater Catch Rates: 1997-2003

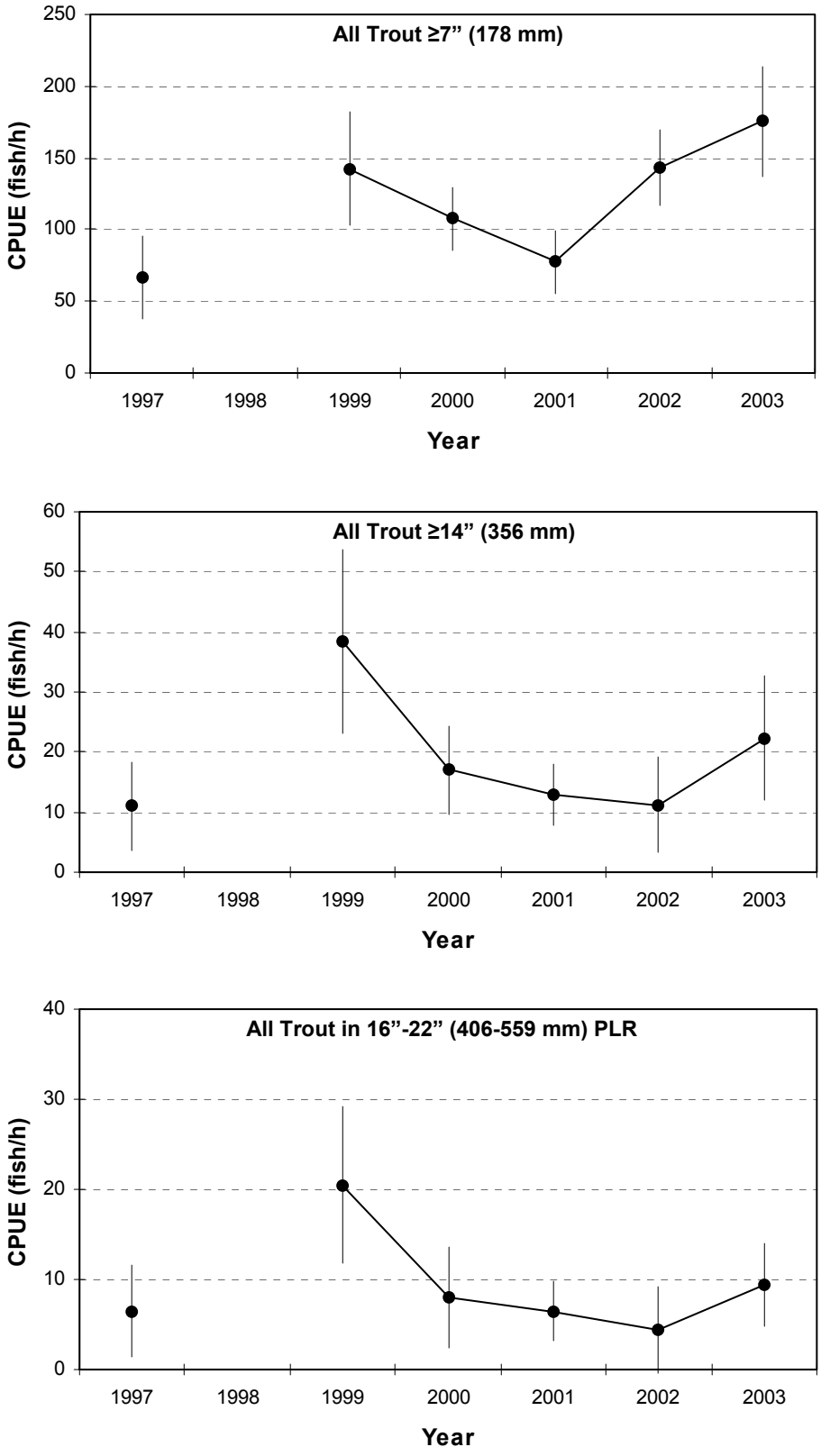


Figure 4. Electrofishing catch rates (all trout) for the 12 South Holston tailwater monitoring stations established in 1997. Bars indicate 90% confidence intervals.

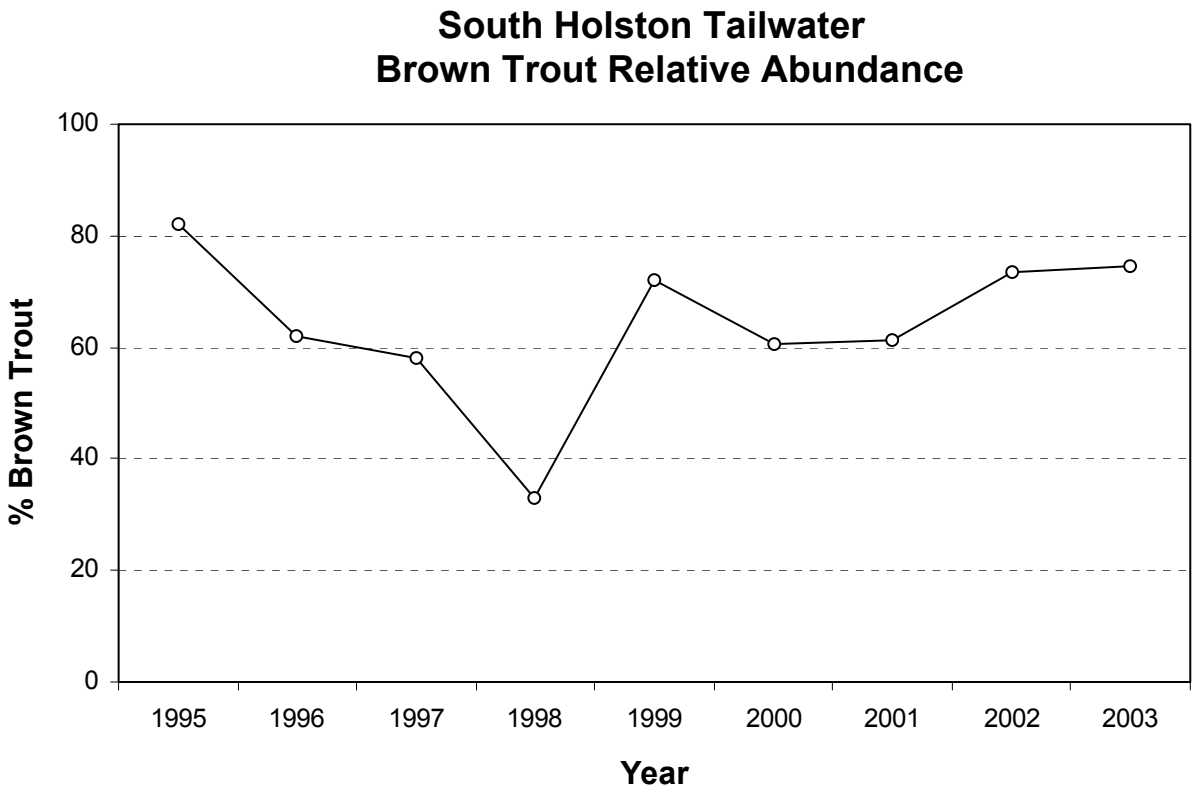


Figure 5. Brown trout relative abundances for all South Holston tailwater samples since 1995. Relative abundances are based on fish ≥7 inches (178 mm). Data for 1995, 1996, and 1998 are from late July/early August; other data are from early March.

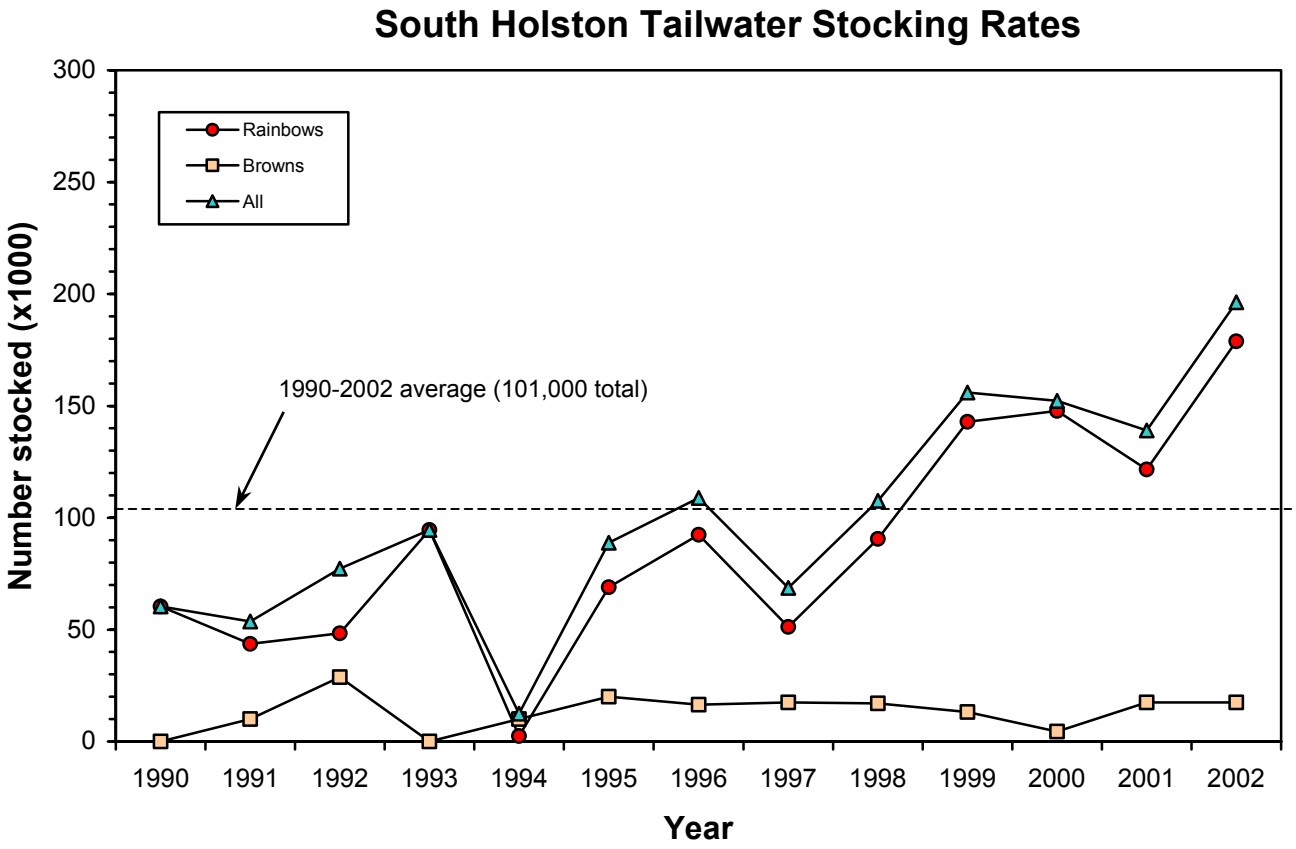
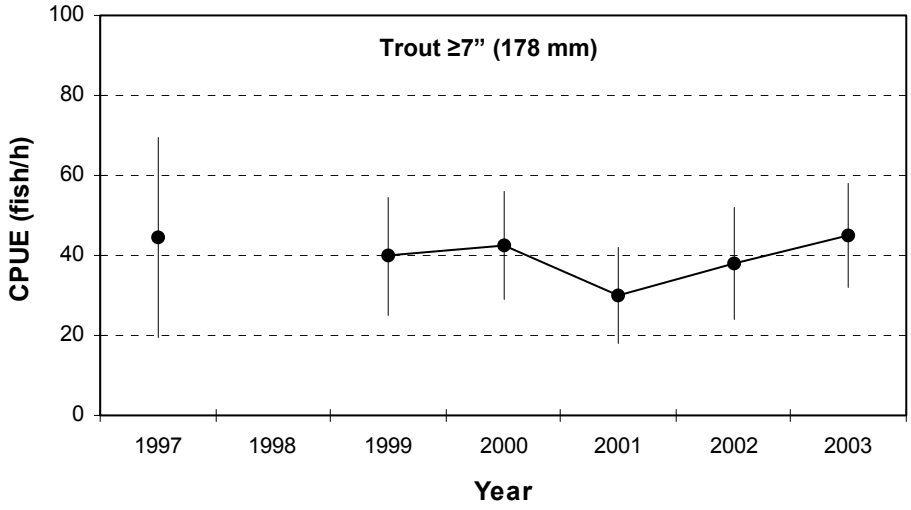
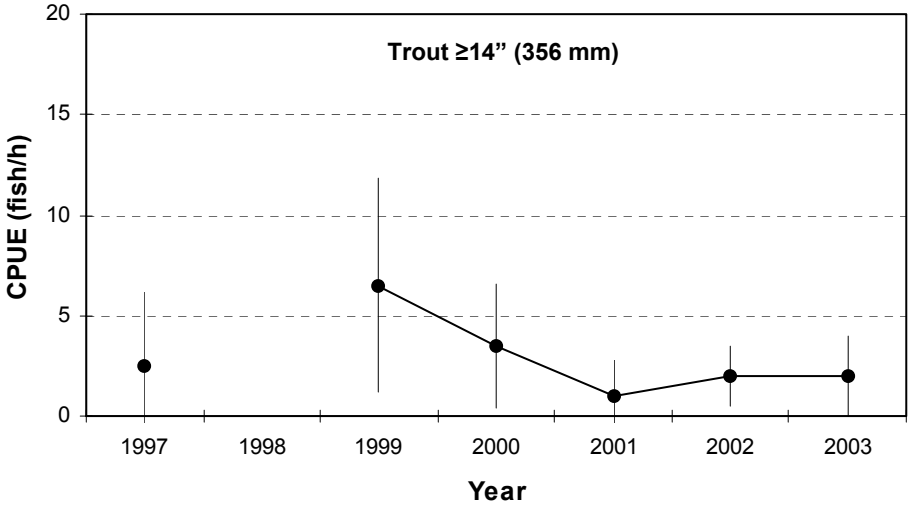


Figure 6. Recent trout stocking rates for the South Holston tailwater. Most fish stocked have been rainbow trout fingerlings (51,000/year). About 37,000 catchable rainbow trout and 13,000 brown trout were also stocked annually.

Rainbow Trout Catch Rates: 1997-2003





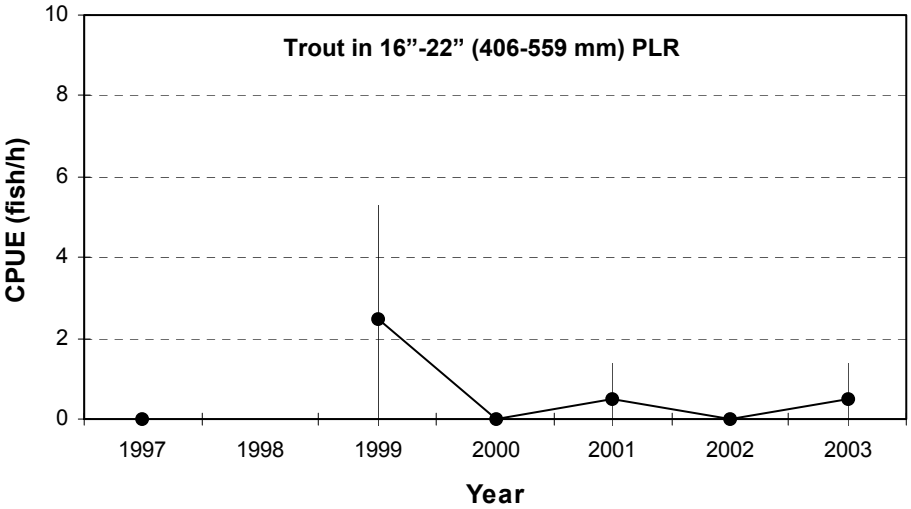


Figure 7. Electrofishing catch rates for rainbow trout from the 12 South Holston tailwater monitoring stations (1997-2003). Bars indicate 90% confidence intervals.